Class I Area Impact Analysis Protocol

Calciners A & B Fuel Switch

SOLVAY SODA ASH JV
GREEN RIVER, WY

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List of Acronyms

ANC	Acid Neutralization Capacity
AQRV	Air Quality Related Value
DEQ	Wyoming Department of Environmental Quality
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
FS	Forest Service
IMPROVE	Interagency Monitoring of Protected Visual Environments
IWAQM2	Interagency Workgroup on Air Quality Modeling (2nd)
MM5	Fifth-Generation NCAR/Penn State Mesoscale Model
SWWYTAF	Southwest Wyoming Technical Air Forum
USDA	U.S. Dept. of Agriculture
VR	Visual Range

SECTION 1.0

INTRODUCTION

Solvay Soda Ash JV (Solvay) proposes to modify two of its calciner combustion systems (Calciners A and B, also known as Source 17) to be fired on coal instead of natural gas, the current fuel. Source 17 was fired on coal through 1995, when the natural gas burners were installed. This proposed calciner fuel switch will cause an increase in potential NO_x and PM_{10} emissions. A permit application will be filed with the Wyoming Department of Environmental Quality (DEQ) for the modification of this facility. As a part of the environmental impact assessment, the anticipated impacts from this modification on nearby Class I areas are to be evaluated, and this protocol describes the proposed methods for this impact evaluation. Specifically, the impacts will be evaluated in relation to: 1) Class I PSD increments and 2) adverse impact thresholds for Air Quality Related Values (AQRVs).

This protocol describes the proposed facility modifications, proposed methods for evaluating the associated Class I impacts, the assumptions to be made in the evaluation, baseline and natural background conditions, the relevant ambient standards, and USDA Forest Service recommended impact thresholds.

Solvay is located in Sweetwater County of Southwestern Wyoming in Section 31, T18N, R109W, and at coordinates 41.4942 degrees N and 109.7615 degrees W. There are two wilderness areas within a 200-km radius of Solvay; they are the Bridger and adjacent Fitzpatrick Wilderness Areas. Solvay is at an elevation of about 6,200 feet, 85 miles (136 km) south-southwest of the closest point of the nearer wilderness area, which is Bridger. These wilderness areas are mostly at a high elevation and contain the Wind River Range, which rises to over 13,000 feet at the north end. The facility location along with the Class I areas in the region are shown in Figure 1.1. Figure 1.1 also shows the locations of the towns in the region. The closest town to the facility is Green River (population 13,000), located about 20 miles east. Other towns close to the facility are Rock Springs (35 miles east, population 19,400), Kemmerer (50 miles northwest, population 3,000), and Evanston (65 miles southwest, population 11,400). Figure 1.2 shows the west view of the facility, and the combined stack for Calciners A and B is identified.

The CALPUFF modeling system will be used to estimate concentrations within the Class I areas, including Class I PSD increment consumption, following for the most part the Southwest Wyoming Technical Air Forum (SWWYTAF) methods. The 1995 SWWYTAF data sets will also be used to generate the regional wind field. Impacts on the two AQRVs of visual range (VR) and acid neutralization capacity (ANC) will be estimated generally following the FLAG 2000 guidelines. Since these areas are beyond 50 km, impacts in the form of distinct plume characteristics (contrast) will not be considered an issue (FLAG 2000, Section D, 2, c, Near Field Analysis).

Figure 1.1: Solvay Location and Nearest Class I Areas

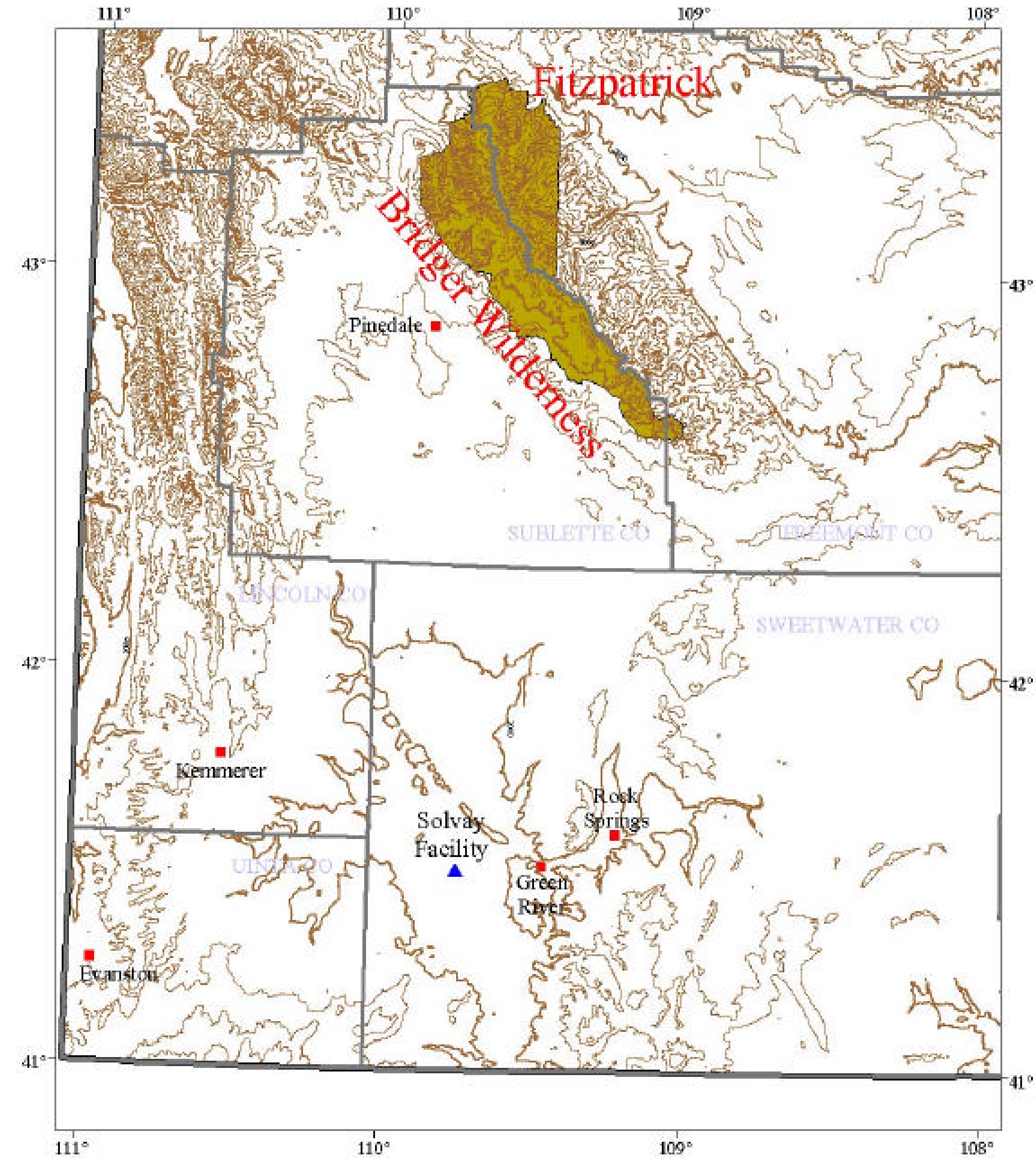

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Figure 1.2: West View of Facility

SECTION 2.0

CHARACTERIZATION OF THE FACILITY

Solvay is an existing underground trona mine with surface processing facilities. The trona ore (sodium sesquicarbonate dihydrate [Na_2CO_3?$NaHCO_3$?$2H_2O$]) is processed into sodium-based products, including soda ash (sodium carbonate [Na_2CO_3]). Construction of the facility began in 1979, and it became operational in 1982. Its sources consist principally of calciners, dryers, boilers, and material handling processes. The facility is presently permitted under Operating Permit 30-126 and has a potential to emit 405 tpy of particulate matter (PM_{10}); 619 tpy of sulfur dioxide (SO_2); 2,440 tpy of nitrogen oxides (NO_x); 2,464 tpy of volatile organic compounds (VOC); and 7,431 tpy of carbon monoxide (CO). There are four gas-fired calciners, two gas-fired dryers, two coal-fired boilers, and other smaller gas-fired combustion units. The purpose of the calciners is to convert the trona ore to a crude soda ash by driving off the CO_2 and H_2O.

Solvay is proposing to convert Calciners A and B (Source 17) from natural gas-firing to coal-firing. These calciners are vented to a common stack with the stack parameters provided in Table 2.1. Potentials to emit and 2000/2001 actual emissions are shown in Table 2.2. From Table 2.1 it is apparent that with the shift to coal-firing, there will be a 20-percent reduction in the heat rate, but an increase in airflow, resulting in a substantial increase in airflow per unit of heat. The other stack parameters will remain the same.

Table 2.1: Source 17 Physical Stack Parameters

Description	Present	Proposed
Height	180.5 ft	180.5 ft
Heat Rate	500 MMBtu/hr	400 MMBtu/hr
Exit Diameter	12 ft	12 ft
Exhaust Velocity	44 ft/sec	96 ft/sec
Exhaust Temperature	375°F	400°F
Flow Rate	312,000 ACFM	650,000 ACFM
Location	603,686 m (East)	Unchanged
	4,594,808 m (North)	Unchanged

The 2000/2001 averaged actual emission rates and permitted potential to emit (PTE) for Source 17 are provided in columns 2 and 3 of Table 2.2. The proposed PTE under coal-firing of Source 17 is listed in column 4. For purposes of determining the triggering of “Major Modification” (Wyoming Air Regulations, Chapter 6, Section 4(a)(x)) source review requirements, Sub-section xii requires a calculation of the “net emissions increase,” which is the difference between the proposed PTE and the present actual emissions. The review threshold amounts are listed in column 5. The Net Emissions Increase is provided in column 6. From this it is apparent that NO_x, CO, PM_{10}, and VOC emissions are to be reviewed by the Major Modification or Chapter 6, Section 4 review procedures. These include Class I area impact analyses (Section 4(b)(vi) and (vii)). This protocol addresses the methods for evaluating the Class I area impacts.

Table 2.2: Source 17 Emission Rates (tpy)

Pollutant	Present Actual Emissions*	Present Potential to Emit	Proposed Potential to Emit	MM Review Threshold	Increase from Present Actual to Proposed PTE	MM Review Triggered?
NO_x	49.2	131.4	788	40	739	Yes
CO	1,077	6,675	5,533	100	4,455	Yes
PM_{10}	32.4	97.7	180	15	148	Yes
VOC	1,199	3,399	2,710	40	1,510	Yes

* Average of years 2000 and 2001

Comparing present potential with proposed potential to emit, the increased NO_x emissions are due to an increase in the emission factor (mass of NO_x per unit of heat) for the stoker-coal burner, which has inherently less complex flame temperature control. Although there will be sulfur in the coal, the trona ore will effectively absorb all of it during the calcination process, which was previously demonstrated by stack tests when Source 17 was originally fired on stoker-coal. (Note that trona and soda ash are commonly used as SO_2 scrubbing agents.) There will be a minor increase in the burner's CO emission factor, offset by the decrease in trona feed rate and the CO emissions inherent in the trona calcination process. There will be no change in the VOC emission factor, which is almost entirely a function of trona feed rate (mass of VOC per unit of trona feed), but there will be a decrease in VOC emissions because of a decrease in the trona feed rate. There will be no increase in the PM_{10} emission factor (mass of PM_{10} per unit of airflow through the electrostatic precipitator). However, since there will be an increase in airflow, there will be an increase in the mass of potential PM_{10} emissions. The emissions estimate is provided in Appendix A.

For the purpose of modeling these emissions, the SWWYTAF assumption of a NO/NO_2 split of 90 percent NO and 10 percent NO_2 is made. Therefore, a NO_x increase of 739 tpy is split into 434 tpy of NO (739 * 0.9 * 30/46) and 74 tpy of NO_2.

SECTION 3.0

IMPACT THRESHOLDS

The Wyoming Chapter 6 Permitting Requirements, Section 2(c)(iii), require that the impacts of any proposed facility not cause an exceedance of the Class I area increments. These increments are provided in Table 3.1. Moreover, the EPA has proposed (FR July 23, 1996, pp. 38,249 – 38,344) to allow for a demonstration of "insignificant impact," which exempts a proposed facility from performing a full increment consumption analysis. (DEQ follows this procedure.) The levels of "insignificant impact" for NO_x and PM_{10} are also provided in Table 3.1.

Table 3.1: Proposed Class I Area PSD Increments and Modeling Significance Concentrations

Pollutant	Increment ($\mu g/m^3$)	Significance ($\mu g/m^3$)
NO_x - annual average	2.5	0.1
PM_{10} - annual average	4.0	0.2
PM_{10} - 24-hour maximum	8.0	0.3

The USDA Forest Service has proposed (http://www.fs.fed.us/r6/aq/ natarm/r4/ bridger_ct.htm) a concern threshold for visual range and acid neutralization capacity. The impacts from the proposed Solvay Source 17 modification will be compared with an impact of at least 5 percent of natural background extinction ($ß_{ext}$) for the individual source.

The second AQRV is acid deposition to surface waters. The threshold for "potential to impact" for acid deposition to wilderness lakes is the larger of the following:

- a relative change of 10 percent in ANC (eq) relative to baseline, and
- an absolute change in lake alkalinity of 1 μeq/l.

SECTION 4.0

AQRV BASELINES

4.1 Visual Range Natural Background

The AQRV impact analyses incorporate baseline values. The visual range analysis will be prepared using two sets of background values, one based on the default values recommended by FLAG 2000, and one based on measured values as representative of "natural background." Suggested default values of the VR natural background are provided in the FLAG 2000 guidelines (Table 4.1). The measured constituent data for Bridger/Fitzpatrick is provided in Table 4.2.

Table 4.1: Natural Background Visual Range Parameters for the Bridger and Fitzpatrick Wilderness Areas as Proposed by FLAG (2000)

Season	Dry Hygroscopic (Mm^{-1})	Non-Hygroscopic (Mm^{-1})	Rayleigh Scattering (Mm^{-1})
Winter	0.6	4.5	10.0
Spring	0.6	4.5	10.0
Summer	0.6	4.5	10.0
Fall	0.6	4.5	10.0

Table 4.2: Summary of Measured Background Visual Range Parameters at the Bridger/Fitzpatrick IMPROVE Monitoring Site, 1988-1999

Season	Dry Hygroscopic (Mm^{-1})	Non-Hygroscopic (Mm^{-1})	Rayleigh (default)
Winter	0.81	1.96	10.0
Spring	1.99	3.41	10.0
Summer	1.91	6.10	10.0
Fall	1.40	3.60	10.0

The measured background VR values in Table 4.2 were calculated as follows. The data from 1988 to 2001 for the IMPROVE site at Bridger (BRID1) were obtained from the IMPROVE website. Only data up to 1999 were included in the analysis, since the 2000 and 2001 data had not undergone the highest level of quality control. Background levels were calculated for non-hygroscopic and hygroscopic compounds separately. Non-hygroscopic compounds include coarse particulate matter (PM_{10}-$PM_{2.5}$), elemental carbon, organic carbon, and soil particles. The hygroscopic compounds include ammonium nitrate and ammonium sulfate (IWAQM2, 1998). Summaries were based on the seasons (FLAG, 2000), specifically, winter (December, January, February), spring (March, April, May), summer (June, July, August), and fall (September, October, November). For each year-by-season combination the 20th-percentile value was calculated for the non-hygroscopic- and (dry) hygroscopic extinction values (units of Mm^{-1}). The background extinctions from 1988-1999 were calculated as the mean of the 20th-percentile values for each season. Only seasons with less than 50 percent of the data present were used in the analysis (Watson, 2002). Based on this criterion the winter season in 1988 was excluded from the analysis.

4.2 Lake Acid Neutralization Capacity Baseline

Two parameters need to be estimated to establish the baseline acid neutralizing capacity (ANC): baseline lake alkalinity (μeq/l) and estimated annual precipitation (m). Baseline lake alkalinity was calculated as the 10th-percentile lake alkalinity values for six lakes in the region (Forest Service, 2000). Data for the indicator lakes were provided by the USDA Forest Service (FS, 2002) and are shown in Table 4.3. The FS data set consists of a series of measurements of the baseline alkalinity, including duplicates, the number of which varied from year to year and lake to lake. The 10th-percentile values were calculated from the entire data set, covering up to an 18-year record (Table 4.3). Blanks and negative values were excluded from the calculation. Note that Upper Frozen Lake was recently added to the set of "indicator lakes." Data collection began in 1997, and to date there have been four samplings: one day per year in July or August for 1997, 1999, 2000, and 2001. For two of the samplings, a duplicate was also collected, making a total of six available readings with a range of 11.4 μeq/l as the highest to 1.3 μeq/l as the lowest. From this extremely small data set, the 10th-percentile most sensitive ANC value is 2.0, which is very low.

Table 4.3: Baseline ANC for Indicator Lakes

Lake	Period of Records	Number of Observations	10th-Percentile Most Sensitive Lake Alkalinities (μeq/l)
Black Joe	1984 –2001	186	60.0
Deep	1984 –2001	172	60.1
Hobbs	1984 –2001	197	70.3
Ross	1985 –2001	140	55.7
Lower Saddlebag	1986 –2001	147	55.8
Upper Frozen	1999 –2001	6	2.0

The second estimated parameter needed to calculate baseline ANC is the annual precipitation at the lakes under consideration (FS, 2000). The annual precipitation at the high elevation lakes in the Class I areas will be based on data from two deposition stations, the CASTNET site PN165 (Pinedale) and the NADP site WY06. These sites are located approximately 19km south from the site used to monitor visibility in the Bridger Wilderness Area (IMPROVE site BRID1) and approximately 40 km from the western border of the Bridger Wilderness Area. Both sites are located at approximately 2,400 m ASL, at elevations similar to many of the lakes (SWWYTAF, 2001).

SECTION 5.0

FACILITIES COMPETING FOR INCREMENT CONSUMPTION

In the event that the increment impact analysis for either PM or NO_2 (there will be no SO_2) shows that the Source 17 impacts are greater than the Class I area "significance" levels, shown in Table 3.1, a cumulative impact analysis will be performed. This analysis will provide the net impact from all source changes contributing to the increment consumption (negative or positive) on a per-pollutant basis. The increment-consuming or -expanding emissions will be calculated as the difference in emissions between the most recently available potentials in the DEQ permit files and the potentials as of the baseline date. The trigger dates for both major and minor sources are listed in Table 5.1.

Table 5.1: Baseline Trigger Dates for Southwest Wyoming

Pollutant	Major Source Baseline Date	Minor Source Baseline Date
PM	January 6, 1975	February 22, 1979
NO_2	February 8, 1988	February 26, 1988

The domain for the sources to be considered in the cumulative impact analysis will be as follows:

- all major sources within the five-county region of Southwest Wyoming (Sweetwater, Uinta, Lincoln, Freemont, and Sublette),
- all minor stationary sources within a 50-km boundary of the Wilderness area (an oblong shaped minor source domain), and
- highway emissions within the minor source domain for US 287 and US 191.

Stationary source emission changes between 1988 and the present will be included according to the difference in potential emissions, while highway emission changes will be included according to actual emissions (1987 and 2001).

Actual gas well field emissions (construction, development, and production) within the minor source domain will be included. The inventory will be developed in a statistical and spatially gridded manner similar to that used for SWWYTAF. The same per-well emission factors will be used.

Urban emissions will not be included because they are extremely small. From the Northeast Wyoming Emissions Inventory (Air Sciences Inc., 2002), the change in urban NO_x emissions from 1987 to 2000 was 12 tons per year (increase) for a 1987 population of 104,000. The 1995 population total of Riverton, Lander, and Pinedale combined was 18,500. Assuming the population changes are similar and consumption habits are similar, the NO_x emissions from these three towns would change by about 2 tons per year, which is insignificant compared with the changes in compression in the domain.

SECTION 6.0

DISPERSION ANALYSIS

6.1 Model Selection

Because the Class I areas are more than 50 km from the Solvay facility, long-range transport is applicable. The Interagency Workgroup on Air Quality Modeling Phase 2 Summary Report and Recommendations for Modeling Long-Range Transport Impacts (IWAQM2), Federal Land Managers Air Quality Related Values Work Group Phase I report (FLAG, 2000), recommends the use of the CALPUFF modeling system (Version 5.4) for evaluating impacts on a regional scale. CALPUFF is a multi-layer, gridded, non-steady-state lagrangian puff dispersion model that can simulate the effects of temporally and spatially varying meteorological conditions on pollutant transport and dispersion.

At DEQ's request, the Southwest Wyoming Technical Air Forum (SWWYTAF) 1995 CALPUFF analysis (February 2001) will be used as the basis for this analysis. The objective of the SWWYTAF study was to evaluate the degree of degradation of air quality, visibility, and other AQRVs in the Fitzpatrick and Bridger Class I areas caused by all upwind sources (natural and anthropogenic), and to evaluate the performance of the non-steady-state CALPUFF dispersion model and its associated wind field model CALMET in predicting the measured air quality and AQRVs during 1995 in the Class I areas. Air Sciences Inc. has a copy of the SWWYTAF data files (2001) that were provided by the DEQ.

Details of the SWWYTAF study are summarized below, with emphasis on proposed changes from the SWWYTAF approach.

6.2 Geophysical Data

The modeling domain and geophysical data from the SWWYTAF study will be used. The SWWYTAF modeling domain includes the southwestern portion of Wyoming, northeastern Utah, southeastern Idaho, and northwestern Colorado, and consists of 116 by 100 grid cells at a 4-km spacing, which corresponds to a domain of 464 km in X by 400 km in Y. The southwest corner has the coordinates of -335.0 in X and -258.0 in Y. The coordinate system is a Lambert Conic Conformal (LCC) coordinate system with standard latitudes of 30 and 60 degrees, reference latitude of 42.55 degrees, and reference longitude of 108.55 degrees. The SWWYTAF terrain data were extracted from a 1-degree Digital Elevation Model (DEM), which has an approximate grid spacing of 90 meters. The land use data were extracted from the USGS composite theme grid (CTG) 1:250,000 (1 degree) scale files. These data were processed for the SWWYTAF study and are contained in the GEOSWY.DAT file.

6.3 Meteorological Data

In the SWWYTAF study, the time-varying large-scale wind flow was derived using a combination of the coarse-grid (20 km) MM5 simulations, direct surface observations, and vertical sounding. The MM5 data were generated by the National Center for Atmospheric Research (NCAR) using the PSU/NCAR Mesoscale Model System, Version II. The data have 11 standard levels (surface, 1000, 850, 700, 500, 400, 300, 250, 200, 150, and 100 hPa) and include two-dimensional snow cover, the sea surface temperature, the sea level pressure, and three-dimensional variables of temperature, geo-potential height, U and V components of wind, and RH.

In addition to the MM5 data, CALMET requires hourly surface observations of wind speed, wind direction, temperature, cloud cover, ceiling height, surface pressure, relative humidity, and precipitation type (e.g., snow, rain). For SWWYTAF, a total of 22 surface stations were used and are listed below. Hourly observations from these stations were processed for SWWYTAF and will be used in this analysis.

Table 6.1: Surface Meteorological Data Stations Used in the SWWYTAF Analysis

Surface Station	Source
Casper, WY	NWS
Cheyenne, WY	NWS
Denver, CO	NWS
Lander, WY	NWS
Grand Junction, CO	NWS
Pocatello, ID	NWS
Rock Springs, WY	NWS
Salt Lake City, UT	NWS
Rawlins, WY	FAA
Riverton, WY	FAA
Baggs, WY	Mt. Zirkel Study
Craig, CO	Mt. Zirkel Study
TG Soda Ash	Industrial Site
OCI	Industrial Site
Naughton	Industrial Site
General Chemical	Industrial Site
Amoco	Industrial Site
Exxon	Industrial Site
Pinedale	NDDN
Centennial	NDDN
Yellowstone NP	NPS
Craters of the Moon NP	NPS

CALMET also requires twice-daily observations of the vertical profiles of wind speed, wind direction, temperature, and pressure. For SWWYTAF, there were four sites observed for upper air data, which are listed below. The data from these sites were processed for SWWYTAF and will be used in this analysis.

Table 6.2: Upper Air Meteorological Data Stations Used in the SWWYTAF Analysis

Upper Air Station	Source
Denver, CO	Twice-daily upper air (TD6201) soundings (NWS)
Grand Junction, CO	Twice-daily upper air (TD6201) soundings (NWS)
Lander, WY	Twice-daily upper air (TD6201) soundings (NWS)
Salt Lake City, UT	Twice-daily upper air (TD6201) soundings (NWS)

In order to calculate wet deposition rates, CALMET requires hourly precipitation rates across the domain. Generally, most precipitation stations tend to be at lower elevations. However, because the presence of high terrain can substantially enhance the amount of precipitation, the use of only the lower level stations can result in an underestimate of the precipitation in areas of elevated terrain. Therefore, in the SWWYTAF study, additional sources of precipitation data were used to properly characterize the precipitation patterns in the SWWYTAF domain. For SWWYTAF, 4-km resolution PRISM climatological precipitation data were used to convert the 20-km MM5 predictions to a 4-km resolution and to produce a more representative terrain-induced spatial pattern. Likewise, the observed hourly precipitation data were scaled by the PRISM annual values for consistency. The scaled MM5 data were combined with the scaled hourly precipitation observations to produce the final precipitation field. This scaled SWWYTAF precipitation file will be used in this analysis.

In CALPUFF, the RH at a point in the domain is obtained from the nearest surface station record. Because most surface stations tend to be at elevations much lower than the Class I areas, the RH at the surface site may not be representative of the RH in the Class I areas. Air Sciences Inc. proposes to incorporate terrain-based RH as an input into CALPUFF. The terrain-based RH will be derived using surface level RH from the MM5 data set at nodes in areas of elevated terrain or that are far from a surface station. These data may be spatially averaged (not vertically) if there are considerable discrepancies between the MM5 and surface station RH values. The new terrain-based RH values will be introduced into CALPUFF as a series of pseudo surface stations added to the surface observation file. The resulting VIS.DAT file from CALPUFF will be used in the visibility calculations, resulting in a consistent RH record for all calculations.

This approach differs slightly from the SWWYTAF approach and is proposed herein because the SWWYTAF approach is not internally consistent. SWWYTAF used one scheme for the visual range impacts and another for the atmospheric chemical transformations. Secondly, the

SWWYTAF schemes are not consistent with guideline (IWAQM2, 1998) regulatory application methods.

6.4 Wind Field Generation

The time-varying wind fields will be generated using the CALMET program and the SWWYTAF geophysical data file (GEOSY.DAT), MM5 data, surface data file (with RH pseudo stations added), upper air data files, and scaled precipitation data. The only difference in the files used for this analysis and the files used for SWWYTAF will be the inclusion of the extracted RH data into the surface file. CALMET will be run using the model setting as used in SWWYTAF.

Since the SWWYTAF wind fields were thoroughly reviewed, a consistency check will be made to verify that the wind fields generated for this application are the same as those generated for SWWYTAF.

6.5 CALPUFF Settings and Execution

Once the CALMET wind fields are completed, the CALPUFF model will be run to calculate concentrations, and wet and dry deposition rates of all relevant pollutants. For this analysis, the RIVAD/AM3 chemistry will be used, which will include SO_2, SO_4, NO, NO_2, HNO_3, NO_3, and fine particulate species.

The Class I area receptors from the SWWYTAF study will be used. These receptors are placed every 2 kilometers along the boundary of each Class I area and on a 2-km resolution grid within each Class I area.

Building downwash parameters, as estimated by the Building Profile Input Program (BPIP Version 95086), will be incorporated into the CALPUFF analysis.

Hourly ozone data from the SWWYTAF study will be used. This data includes ozone measurements from six stations: Pinedale, WY; Centennial, WY; Yellowstone NP, WY; Craters of the Moon NP, ID; Highlands, UT; and Hayden, CO.

CALPUFF requires a domain average ambient ammonia (NH_3) concentration. The IWAQM2 recommended value of 1 ppb, representative of arid climates, is proposed for use herein. Given the arid nature of the land and the low NH_3 emission fluxes (< 1 ton/sq. mile/yr) in the modeling domain, the 1 ppb value would be reasonable for this application. (See NH_3 emissions density map from EPA's National Air Pollution Emissions Trends Update, 1970-1997 [1998]; http://www.epa.gov/ttn/chief/trends/trends98/.) This proposed value is corroborated by a SWWYTAF impact estimate of 1.1 ppb region-wide, performed as an ancillary modeling exercise and based upon a region-wide NH_3 emission rate of approximately 0.23 ton/sq. mi/year.

The CALPUFF module will be run using the appropriate Table 2.2 short- or long-term emissions to calculate pollutant concentration, and wet and dry deposition rates at each receptor in the Class I areas.

6.6 PSD Increment Comparison

If Source 17 increases the trigger "significance," a cumulative increment analysis will be needed, and all domain increment-consuming emissions (as described in Section 5.0) will be modeled.

Results of the NO_x and PM incremental impacts will be compared with the allowable PSD increments listed in Section 3.0.

SECTION 7.0

AQRV IMPACT ESTIMATION

The AQRV impact estimates will be performed on the Source 17 emission increases as defined in Section 2.0.

7.1 Visual Range

The CALPUFF module will be run using the appropriate short- or long-term Source 17 emissions to calculate pollutant concentrations at each receptor in the Class I areas. CALPUFF will also be set up to output an RH file (VIS.DAT) for use in the visibility calculation. Then, the CALPOST processor will be used with the concentration and VIS.DAT files to calculate the light extinction (visibility impairment) in the Class I areas. The results will be compared with the thresholds described in Section 3.0.

For the visibility impact calculation in SWWYTAF, the maximum RH used in the particle growth curve (RHMAX) was set at 90 percent. IWAQM2 recommends that RHMAX be set to 98 percent. In a recent review, Watson 2002 notes, "For RH from 90 to 100 percent, a range that is imprecisely measured by most RH sensors, light scattering usually skyrockets. These high RH periods are often removed by scientists before comparing calculated and measured extinction values." … "Surface-based RH measurement of 98-100 percent imply the sensor is in a fog or cloud …"; and "… RH > 95 percent is not well quantified even with the best continuous sensors, and many automated in long-term weather networks are not of the highest caliber." Given the inaccuracy of the RH measurements above 95 percent and that RH values above 97 percent are likely affected by clouds or fog (natural obscurants), Air Sciences Inc. proposes a RHMAX of 95 percent for this application. We expect that even with RH values at around 90 percent that there will be precipitation in the area, especially during the summertime afternoons, when thunderstorms are prevalent.

As mentioned in Section 6.3, the SWWYTAF modified VIS.DAT file will not be used in this analysis. Rather, terrain-based RH values will be inputted into CALPUFF as pseudo stations, and the resulting CALPUFF VIS.DAT file will be used. This will result in a consistent RH record for both the chemistry and visibility calculations.

7.2 Acid Deposition

Sulfur and nitrogen deposition rates will be extracted from the CALPUFF output file using the POSTUTIL and CALPOST programs. POSTUTIL takes the CALPUFF wet and dry deposition files with the CALPUFF defined species (i.e., SO_2, SO_4^{-2}, NO_2, HNO_3, $((NH_4)_2SO_4)$ and calculates S and N deposition rates. The S and N deposition rates in the POSTUTIL output file (g m^{-2} s^{-1}) are calculated using the conversion factors according to the guidelines provided with POSTUTIL:

$$S\ deposition\ (g\ m^{-2}\ s^{-1}) = 0.500*SO_2 + 0.333*SO_4^{-2}$$

$$N\ deposition\ (g\ m^{-2}\ s^{-1}) = 0.304*NO_2 + 0.222*HNO_3 + 0.452*NO_3^{-1} + 0.292*SO_4^{-2}$$

Although not shown in the equation above, the nitrogen from background ammonium is also included in the N deposition rate. CALPOST will be used to extract the S and N deposition for all receptors. One specific receptor will be established for each of the lakes, based on their latitude and longitude. The CALPUFF-calculated wet and dry deposition is further processed using the Forest Service, 2000 screening methodology. Precipitation will be estimated using the routine discussed in Section 4.2.

Results of this deposition analysis will be compared with the Section 3 thresholds.

SECTION 8.0

SOLVAY CLASS I PROTOCOL REFERENCES

FLAG, *Federal Land Managers' Air Quality Related Values Workshop (FLAG) Phase I Report*, December 2000)

EPA, FR July 23, 1996, pp. 38,249 – 38,344

IWAQM2, EPA-454/R-98-019, 1998

J.G. Watson, Visibility: Science and Regulation, *Air & Waste Management Association,* 2002, 52, pp. 628-713

Forest Service, *Users Guide - Screening Methodology for Calculating ANC Change to High Elevation Lakes,* 2000

Forest Service, Excel data transfer from Terry Svalberg, Forest Service, Pinedale WY, to Rodger Steen, Air Sciences Inc. 9/3/2002

SWWYTAF, Earth Tech, Concord MA, *The Southwest Wyoming Regional CALPUFF Air Quality Modeling Study - Final Report including Project Data Files,* February 2001

Air Sciences Inc., *Northeast Wyoming Emissions Inventory*, for Wyoming DEQ, January 2002

APPENDIX A

Proposed Source 17 Emissions Evaluation